CRETACEOUS MICROFAUNA FROM CAMERON HILLS, N.W.T.

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The undersigned hereby certify that they have read and recommend to the School of Graduate Studies for acceptance, a thesis entitled "Cretaceous Microfauna from Cameron Hills, N.W.T." submitted by Donald Lorne Campbell, B. Sc., in partial fulfilment of the requirements for the degree of Master of Science.

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THE UNIVERSITY OF ALBERTA

CRETACEOUS MICROFAUNA FROM CAMERON HILLS, N.W.T.

A DISSERTATION

SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES

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By

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FRONTISPIECE

Looking southwestward to the Cameron Hills, N. W. T.

ABSTRACT

Forty-seven species of Foraminifera are described and figured and are included in thirtden genera (twelve arenaceous, one calcareous): Ammobaculites (twelve species), Ammodiscus (one species), Eggerella (two species), Haplophragmoides (seven species), Leptodermella (one species), Miliammina (seven species), Nodosinella (one species), Proteonina (four species), Quadrimorphina (one species), Textularia (one species), Tritaxia (three species) and Verneuilina (four species). The Cameron Hills section may be correlated with a lower part of the Shaftesbury formation of the Peace River area of Alberta and the upper portion of the Buckinghorse formation of Northeastern British Columbia. The described fauna is of a brackish, shallow, lagoonal type environment.

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The writer would like to take this opportunity to thank the members of the Department of Geology for their assistance and encouragement throughout his graduate and undergraduate years at University.

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CHAPTER I

INTRODUCTION

Introductory Statement

Cretaceous shales are exposed in the Cameron Hills, N.W.T. The purpose of this thesis is to give an exact age to these shales. The scarcity of macrofossils necessitated a microfaunal study. This study has shown the age to be Upper Albian (Uppermost Lower Cretaceous). It is hoped that this microfaunal study will help further our knowledge of the Lower Cretaceous stratigraphy of Western Canada.

Field Work

The material examined was collected by the writer in the Cameron Hills-Tathlina Lake area, Northwest Territories, while working with a J. C. Sproule and Associates field party during the field season of 1954.

The field party consisted of S. R. L. Harding, G. K. Williams, D. L. Campbell, D. Sellers and H. Martell. A Canadian Helicopter Company Model "D" helicopter which was used for transportation and reconaissance was piloted by J. Foster and serviced by H. Wilson.

The northern extremites of the Cameron Hills east of Cameron River was "helicopter traversed" by S. R. L. Harding. No outcrop was seen other than two outcrops on the Cameron River which were sampled by the writer. At a later date while based on the Mackenzie river the writer "fly camped"

on Tathlina Lake for the express purpose of locating Cretaceous outcrop. Well over 300 miles of country was flown and only three more outcrops were encountered. All outcrops were sampled.

Collection and Preparation of Samples

All outcrops were trenched and five and ten foot representative samples obtained. A scarcity of sample bags did not permit five foot sampling throughout. The samples were placed in cotton postal type bags, labelled and sent to J. C. Sproule and Associates, Calgary, and later shipped to the University of Alberta.

In the preparation of samples for picking one-half of each sample was used; the other halfbeing retained at the University of Alberta. To be rid of possible contamination the "cut" sample was placed on a coarse screen and water run briefly over it. Half-pint sealers were labelled appropriately and sample plus water were poured into these, then placed on shelves and allowed to disintegrate.

As samples partially disintegrated they were washed over a set of Tyler screens, mesh size 28, 48, 80, 100, and 140. The residue in each screen was kneaded between the fingers under a small jet of water from a hose connected to a tap until microfauna and sand grains were clear of shale. Samples did not disintegrate readily and the washing of macerated samples took up to three hours. A "Waring" blender, Model PB-5, was then used. A sample was placed in the blender, more water added and turned on to the slow rate for approximately ten minutes and then turned on the fast rate for approximately five minutes. The sample was then washed through the screens. If the

residue on the 28 and 48 mesh screens was too great it was again placed in the blender and run on the fast rate for five minutes. The sample now generally was washed readily through all size screens. Washing of a single sample was now cut down to 45 minutes rather than three hours. Samples which ordinarily could not be washed could now be washed in 45 minutes. The residue of each screen was washed into a plain porcelain saucer and the excess water poured off. A preliminary check with a binocular microscope was made on all samples while still wet. The residue in the pan was washed by decantation. Residues of the pan and 28 mesh size screen were examined while still wet and if not found significant were discarded. White file cards were labelled as to location and mesh sizes. These cards remained with the samples and were used for notations.

All residues were dried in an electric oven at the temperature of 100°F. After drying, samples were put in labelled screw capped vials until ready for picking.

A dry sample was now spread evenly over a light blue plastic picking tray. The tray was marked with parallel lines one-quarter of an inch apart. This was the width of field of the binocular microscope at 20 power. A Reichert Wein binocular microscope was used for all examination. A wetted, untrimmed sable hair art brush, size 00 was used to transfer specimens from the picking tray to the mounting slide. The residue of the 48 mesh screen was more readily picked by setting the microscope at 10 power while 20 power was more suited to the 80 and 100 mesh size. Picked specimens were placed at the edges of the slide. Slides used

were of the ten cell oil-field type. Five cells were generally used per sample and each cell labelled as to mesh size. The cells were of black mat and were treated with gum tragacanth mixed with a small amount of formaldehyde to prevent molding. When sufficient microfauna were picked, the slide was placed under the binocular microscope and specimens placed in horizontal rows roughly arranged to morphological similarities. When a microfossil is placed in the cell the gum tragacanth softens with moisture from the brush and hardens upon drying holding fast to the specimen. The percentage of the sample picked was noted on sample reference cards and the remaining unpicked sample was replaced in the screw top vial for future reference if necessary.

Drawing of Hypotypes and Plate-making

Hypotypes were picked and placed in single celled slides equipped with plastic cover slips. A Spencer camera lucida mounted on a Spencer binocular microscope was used to draw 60X penciled drawings on white index cards. A Riechert-Wien binocular microscope adjusted to 40X was used to see the final details for the drawings. The light source was from the left hand side of the microscope.

The finished drawings were then photographed. The Department of Geology was equipped with facilities required for the photography. It was endeavoured to have hypotypes reproduced to 60X on a smooth mat paper. The photographs were then cut out and mounted on black surfaced paste board. Photographs of hypotypes were numbered, retouched and then rephotographed for the production of the final plates.

CHAPTER II

CAMERON HILLS AREA

Previous Work

The Cameron Hills until fairly recently have been relatively inaccessible. Inaccessability and scarcity of outcrop combined to restrict investigation so consequently little is to be found in past literature about the geology of the area.

Cameron (1921) writes "The country west of Hay River is little known. Akin[1] reports that the country for 35 miles north of Hay River, adjacent to the 6th Meridian is gently rolling and well watered by numerous streams flowing east to Hay River. Then there is an abrupt rise at the escarpment of Cutknife Hills to an elevation of 2700 feet. Cutknife hills appear to be a broad, gently rolling plateau dotted with numerous small lakes, which apparently drain westward to the head waters of Kakisa river. Near Grumbler rapids on Hay River the escarpment of Swede mountains, 2500 feet in elevation, shows to the west at a distance of about 15 miles. The escarpment is apparently a continuation of that of Cutknife [Cameron] hills to the southwest and probably connects with the Eagle Mountains escarpment to be seen to the south from Great Slave Lake and Mackenzie River".

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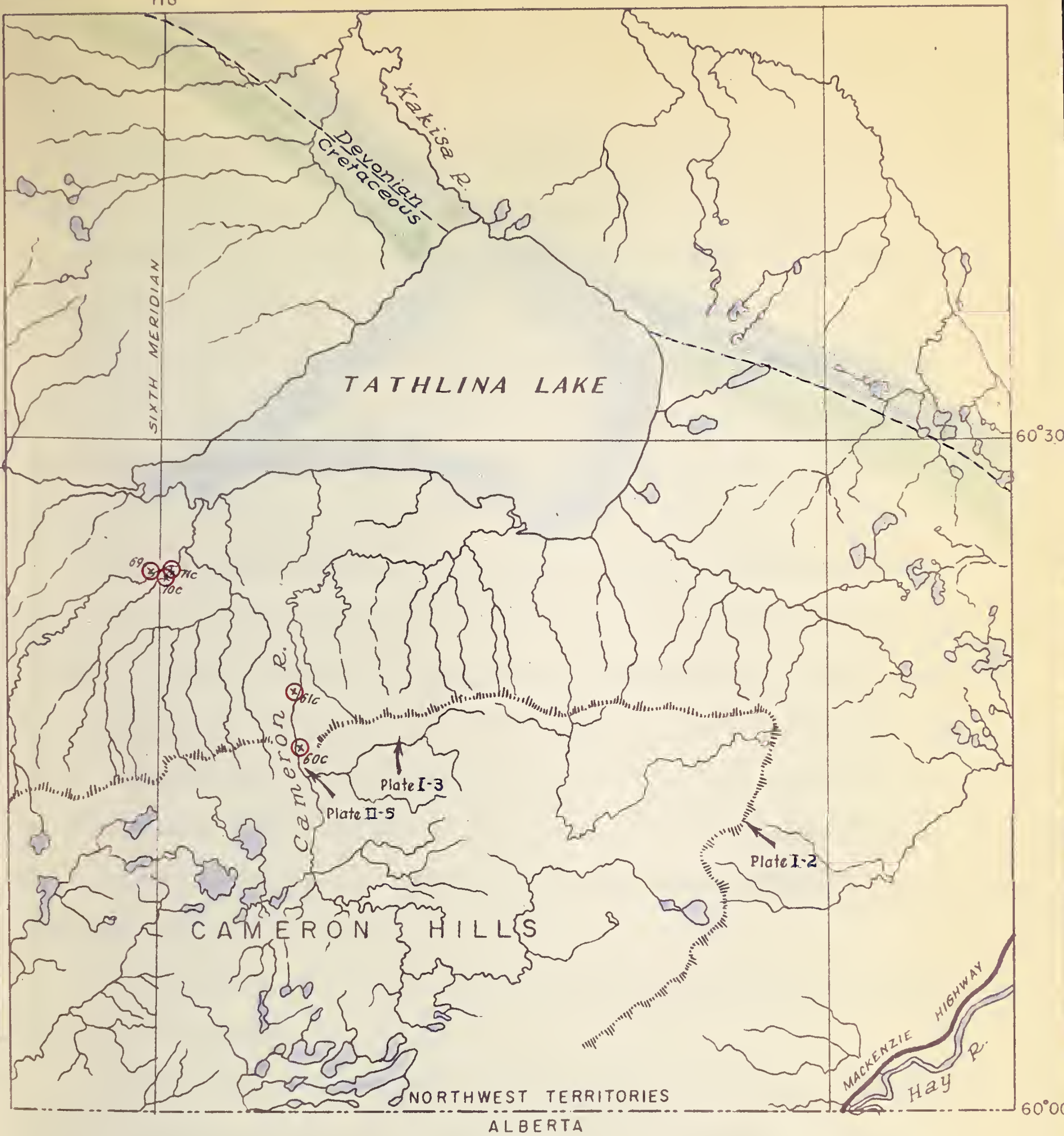
(1) Akin, J. R., "6th Meridian-27th Baseline to 60th Parallel," Ann. Rept., Dept. of Interior, Topographical Surveys Branch, 1916.

FIGURE - I



LOCALITY MAP

CAMERON HILLS AREA N.W.T.

8 4 0 8

Scale 1" = 8 miles

69c
x Outcrop Location

The Swede mountains are a continuation of the Cameron hills but they do not connect with the Eagle mountains. The Eagle mountains are the Upper Devonian escarpment while the Cameron Hills are underlain by Cretaceous sediments.

Cameron goes on to write "It is probable that Cretaceous sediments underlie most of the southern section of the area under discussion but the known exposures are confined to the valleys of the Peace and Hay Rivers."

On the Hay River from the 6th Meridian crossing to within a few miles of the first limestone outcrop near Grumbler rapids, Cameron found outcrop in numerous places and said they were generally analagous to the Loon River series of McConnell's (2) Peace River section. Having found no fossil evidence Cameron made no attempt at correlation, named them the Meander shales, classified them as Cretaceous in age and stated that for the most part they probably represented the Loon River series of the Peace River valley.

The Meander shales are the closest Cretaceous outcrop to the Cameron Hills seen by earlier workers.

Whittaker (1921) makes reference to the Cameron Hills in referring to Mr. Siebert of the Topographical Survey but did not visit them himself. Whittaker writes "South of the lake [Tathlina] the land rises rapidly for several hundred feet to form what are locally known as the Cutknife hills. A deep valley is cut in these hills by a large river which enters the lake 12 miles east of its western end."

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(2) McConnell, R. G. "District of Athabasca. Geol. Surv., Can., Ann. Rept., new ser., vol. V, 1890, pt. D.

Description

The Cameron Hills area is relatively inaccessible. The Mackenzie Highway linking Great Slave lake to Alberta cuts across the southeast corner of the map area. (Fig. 1) Only the northeastern portion of the hills are shown in the map area. The whole area excepting the slope of the Cameron Hills is predominately covered by spruce-muskeg. The country north of the hills is very flat and the drainage is poorly developed. The banks of the streams are very low and the water slow moving. The streams have very low gradient and are not entrenched. Were it not for the drainage on the immediate banks of the streams permitting tall spruce to grow, the streams in many cases would not be at all apparent. This tall spruce shows well on air photographs and greatly aids in helicopter traverse of the streams. The northern part of the Cameron Hills is covered by spruce, brûlê, second growth jackpine and strewn with glacial boulders.

Glaciation

Glaciation is evident over the whole area. The writer is of the opinion that in pre-Pleistocene times, a major Cretaceous escarpment existed at about the present position of the Cameron Hills and rose above a marshy or muskeg plain underlain by shales, that is, the condition was much the same as today. It is also suggested that the escarpment was dissected by a river which was in much the same position as the present Cameron River. The erosional contact of the Cretaceous

PLATE I

Figure 2. Stratified glacial drift high up on the Cameron Hills, N.W.T.

Figure 3. Stratified glacial drift within the Cameron Hills, N.W.T.

and Devonian would be further north and east of the present suggested boundary. An ice sheet (no differentiation of ice sheets will be made) moving in from the east or northeast would over-ride the erosion resistant Devonian limestone and upon reaching the Cretaceous shales erode the shales. As a result of the ice eroding the shales a basin was formed south of the Devonian-Cretaceous contact in which Tathlina Lake now lies. As the ice sheet moved southward and westward it over-rode and cut into the escarpment modifying it considerably. It is suggested that upon retreat of the ice a lake was formed, the north side of which was held up by the ice and the south shore existed in the head water region of the Cameron river and the summit dividing the Cameron from the Petitot drainage. Melt water from the ice sheet laid down sbratified material on and along the north edge of the hills. The material in many cases is formed largely from Cretaceous shales picked up by the ice. This stratified drift is illustrated by Plate I, figures 2 and 3. Exposures on the Cameron River show in excess of 400 feet of stratified glacial drift. (Plate II, figure 5.) This is probably the result of an infilling of an old stream valley. As the ice sheet retreated past the present edge of the hills the water levels in the proglacial lake probably dropped. Probable stagnation of the ice followed leaving a relatively thin mantle of drift covering the north part of the area. The stratified material found within the Cameron River valley was easily eroded by the post-glacial Cameron River. The headwaters of the river are deeply incised into the hills. Small

PLATE II

Figure 4. Location 69C, on an unnamed stream, in close proximity to the Sixth Meridian 3 3/4 miles south of Tathlina Lake, showing 23 feet of Lower Cretaceous shales.

Figure 5. Stratified glacial drift on the Cameron River, within the Cameron Hills, N. W. T.

streams coming into the Cameron River and at right angles to it are often of very steep gradient, showing youthful V-shaped cross section cut in drift. The material carried down by the Cameron River was deposited as deltaic type materials in Tathlina Lake, pushing the south shore northward. Today, the river flows along the east side of this delta. Tathlina Lake is a shallow lake, and consequently wave action agitate the bottom muds and the lake is murky most of the time. Local people have said it is not over a person's head at the deepest point. There are possibly two main reasons for the lake being shallow:

1. It forms a settling basin for the Cameron and Kakisa rivers.
2. Bottom is underlain by bedrock.

The northeastern edge of the lake is controlled by bed rock and the southern shore by recent sediments from the Cameron Hills.

As a result of glaciation, outcrop is scarce and has been found only near the base and edge of the hills. (Outcrops 60C and 61C, Plate III, figures 6 and 7.) Imperial Oil Company geologists have also reported finding outcrop in the same relative position on the south eastern side of the hills towards Alberta.

Regional Geology

The Cameron Hills are underlain by Lower Cretaceous shales which lie unconformably over rocks of Devonian age.

North of the Cameron Hills, Devonian outcrop is exposed below the mouth of Kakisa River. The G.S.C. Map No. 1045A shows the Cretaceous-Devonian contact south of Tathlina Lake. The writer suggests that the erosional contact of the Cretaceous and Devonian should be on the north

Figure 6. Location 60C, on the Cameron River, 14 miles south of Tathlina Lake, showing 174 feet of Lower Cretaceous shales.

Figure 7. Location 61C, on the Cameron River, $11\frac{1}{2}$ miles south of Tathlina Lake showing 88 feet of Lower Cretaceous shales.

side of the lake. No Cretaceous outcrop was found along the contact but the writer places it underlying the muskeg in close proximity to the first appearance of Devonian outcrop. This was found to be the case northwest of Tathlina Lake, where structure test holes drilled just south of the surface Devonian outcrop encountered Cretaceous shales.

The elevation of Tathlina Lake is 918' m.s.l. In Imperial Bistcho Lake No. 1 (7-7-124-2, W6M) (K.B . 2382) the top of the Devonian is 582' m.s.l. This gives a southwesterly regional dip of the erosion surface on the Devonian of 5 feet per mile. It is probable that the regional dip of the Cretaceous is approximately equal to the same figure.

Location 61C represents 88 feet of section; 2½ miles upstream on the Cameron River is location 60C which represents 174 feet of section. The difference in elevation at water level of these outcrops is 200 feet. Assuming a regional dip of 5 feet per mile, 387 feet of section is present from the base of 61C to the top of 60C and approximately 500 feet is present between the base of 61C and the Devonian (see figure 8).

Personal communication from S. R. L. Harding (J. C. Sproule and Associates, Calgary) indicates that the fish scale sand is absent in the Bistcho Lake Well. Keith Williams of J. C. Sproule and Associates examined the samples of this well and it is his interpretation that there is 865 feet of glacial sand, gravels and boulder clay at the top of the well. A similar interpretation has been made by other geologists. The top of the Devonian in this well is at drilling depth of 1800 feet. This gives the Cretaceous section as a total of 935 feet.

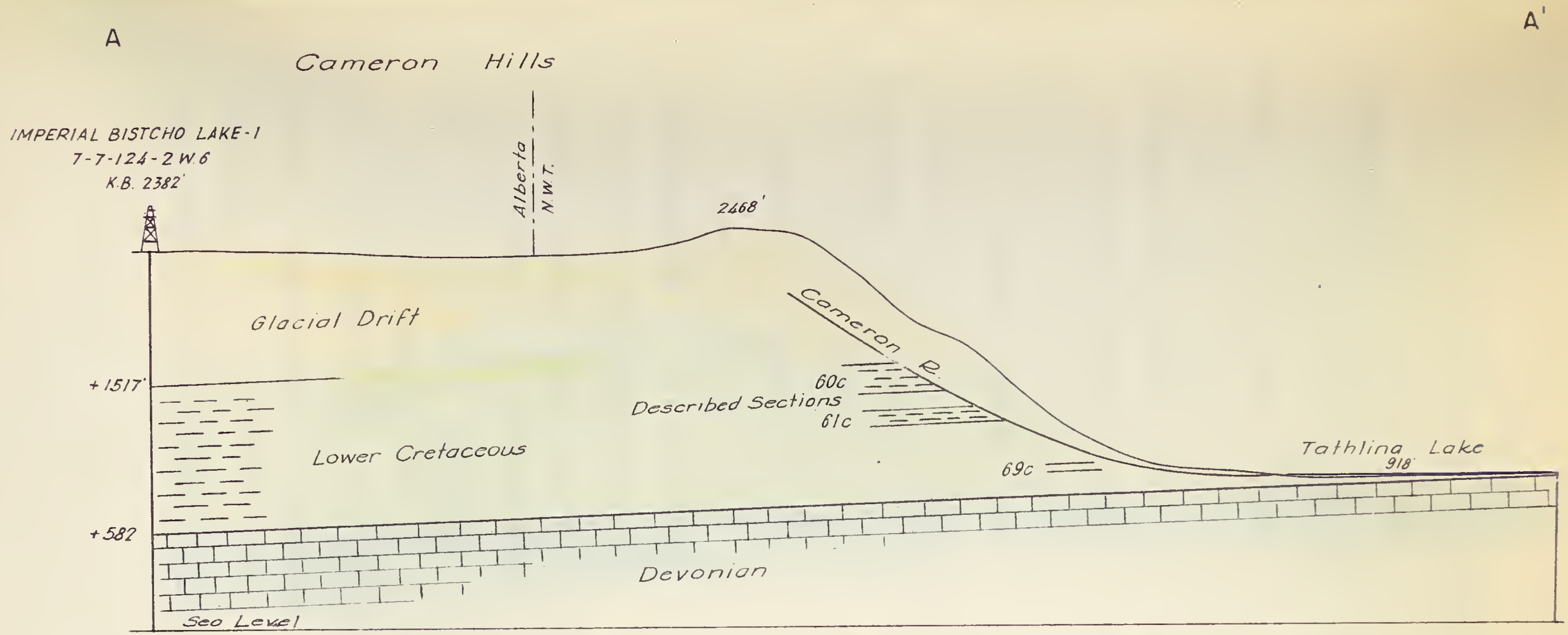
In the Shell-Watt Mountain Strat Test No. 1 (6-24-111-22, W5M) the total thickness is around 1800 feet. The first 300 feet probably include beds of the Dunvegan formation. The fish scale sand, although a reliable wide spread marker in Western Canada is difficult to recognize from E-logs in northwestern Alberta. The stratigraphic position of the fish scale sand is below the Dunvegan formation and probably occurs at a drilling depth of 400 feet in the Shell-Watt Mountain No. 1 well. The top of Devonian in this well is 2016 feet deep, giving an interval from the possible fish scale zone to the Devonian of about 1600 feet. This latter figure exceeds the total section of Cretaceous found at Bistcho Lake so it is probable that the Bistcho Lake well started below the Fish scale sand. The fish scale sand was not found in the Cameron River Valley.

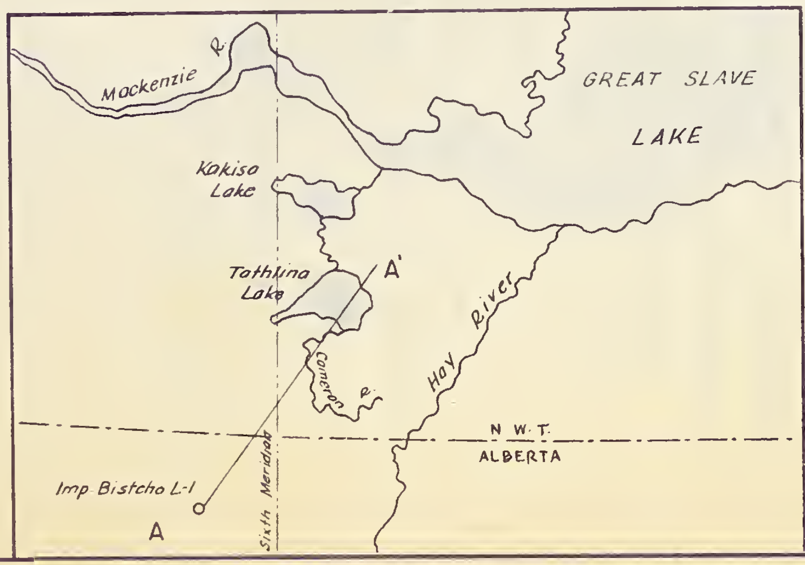
All sections described from the Cameron Hills consisted of medium to dark grey shales with nodular bands scattered through the outcrop. (For detailed description see appendix) No sandstone beds were connected with the shale outcrop.

The E-log of the Bistcho Lake well shows a curve with little expression through the Cretaceous section except for minor "kicks" (Sandy?) at 1560 feet and 1750 feet (pers. comm. S.R.L. Harding). Unfortunately samples at 1750 feet are missing. (It is possible that the Bluesky sandstone occurs at this horizon). On the above evidence the writer concludes that there is no true sandstone member extending this far north within the Lower Cretaceous section.

The contrast of the flooding of the Loon River (<u>Lemuroceras</u>) sea and the Shaftesbury (<u>Neogastroplites</u>) sea is shown on Figure 10. (on back cover)

FIGURE - 8





SEMI-DIAGRAMMATIC CROSS SECTION

BETWEEN

IMPERIAL BISTCHO LAKE-1 AND TATHLINA LAKE

HORIZONTAL SCALE 1" = 8 MILES
VERTICAL SCALE 1" = 1000 FT.

CHAPTER III

STRATIGRAPHIC CONSIDERATIONS

Palaeontology

The microfauna of the Cameron Hills section is lacking in distinctive species. For this reason the writer does not think it feasible to set up faunal zones. An examination of the various suites from a generic standpoint does bring out some pertinent data. (See Appendix II)

Location 69C represent 23 feet of section. Five foot representative samples were taken of this outcrop. The bottom 8 feet and the upper 10 feet were practically barren and did not yield any describable forms. The middle five feet contains Miliammina (50%) Haplophragmoides (25%) Leptodermella (15%), Tritaxia 69C 10-15A (rare), and Ammodiscus 69C 10-15 (rare). Cutinized elements were present but in very minor amounts.

Location 61C represents 88 feet of stratigraphic section and the upper 80 feet was sampled. In the lower 50 feet of sampled section Haplophragmoides is the most abundant followed in number by Verneuilina, Ammobaculites, Trochammina and in minor numbers Tritaxia, Miliammina and Gaudryina. Haplophragmoides gigas minor Nauss and Haplophragmoides linki Nauss are rarely present in this part of the section. In the upper 30 feet of section Gaudryina is more abundant.

Location 60C represents 174 feet of section. The microfauna is predominately Ammobaculites and Haplophragmoides followed in number by Miliammina, Leptodermella and Proteonina. Cutinized microfossils and Verneuilina are more prominent in some horizons. Gastroplites (Neogastroplites?) sp. and Oxytoma pinania occur 6 feet above water level

in the above outcrop. South of the Cameron hills, Neogastroplites sp. and Oxytoma pinania are found within and below the fish scale sand and within the Sikanni sandstone (pers. comm. Dr. C. R. Stelck).

The examination of microfaunal suites from sections on the Athabasca river (Bahan 1951), and from the areas of Edmonton (Eldorena #1 Well, Bullock 1950) and Vermilion (Nauss 1947) was undertaken.

Similar species to those found in the described Cameron Hills section were found to be present in the suites of the Joli Fou formation of the Athabasca River. In the Edmonton (Eldorena #1 well) area similar species are found in the suites of the Viking and pre-Viking shales. In the Vermilion area similar species are found in the suites of the Basal Lloydminster shale and the Cummings member.

It is suggested that these similar species which are in the Cameron Hills section are longer ranging in the north and extend up into the Shaftesbury equivalent in Cameron Hills Area. The possibility also arises that species found in the Basal Shaftesbury in the Peace River area which are similar to those found in the described Cameron Hills section appeared earlier in the north.

Palaeo-Ecology

Phleger, Parker and Pierson (1953, 1954, 1955) in their recent studies on the Gulf of Mexico coast have determined certain biofacies of Foraminifera. One of these is the brackish or near shore facies of the estuary, marsh and sound environments. Some of the common genera of this facies are:

Ammobaculites

Leptodermella

Miliammina

Proteonina

Trochammina

Gaudryina

Haplophragmoides

In the Mississippi Sound area (Phleger 1954), the sound facies is composed exclusively of arenaceous species with Ammobaculites the predominant fauna. Gaudryina and Miliammina are present but more abundant near marshes and streams. Haplophragmoides, Leptodermella, Trochammina, Ammobaculites are characteristic of the marsh facies.

In the Southwestern Mississippi Delta area (Phleger 1955), some of the dominant fauna in the marsh facies is Leptodermella, Miliammina, Trochammina, with Miliammina and Proteonina less abundant. Ammobaculites also occurs with significant frequency. The sound facies is characterized by Ammobaculites and Gaudryina.

The open gulf facies of both of the above areas is composed of over 90% calcareous forms.

The fauna of the described Cameron Hills section is almost entirely arenaceous. The predominant fauna is:

Ammobaculites

Haplophragmoides

Leptodermella

Gaudryina

Proteonina

Trochammina

Verneuilina

This is indicative of a brackish or near shore environment.

The writer offers possible conditions of deposition of the described Cameron Hills section:

It is not difficult to visualize a shore line in the Cameron Hills area when one takes into account their position in the Western Canada Sedimentary Basin. A slowly subsiding mud-marsh shoreline existed. The waters off shore were brackish, shallow and probably not greater than 20 feet in depth. It was probably less than 20 feet deep much of the time. The rate of influx of fresh water would have effect on the abundance of certain genera such as *Miliammina* and *Gaudryina*. Lagoonal conditions might have existed with off shore shoals or barriers giving protection from the open sea. The source of sediments was from the erosion of pre-existing shales which were in an easterly direction from the shore line. The rate of deposition of sediments approximately equalled the rate of subsidence. Variations of the rate of subsidence would shift the environmental conditions from marsh to sound to approaching open sea or any variants thereof.

Correlation of the Cameron Hills Microfauna

The correlation of the various microfauna assemblages of the other described sections to those of the Cameron Hills area was carried out by the examination of hypotypes and microfaunal material when ever possible. Paired species are presented as evidence of correlation and while they may not always be the same species they do have close similarity.

Correlation with the Peace River Area (Nielsen 1951)

The microfaunal assemblage of the basal part of the Shaftesbury formation below the fish scale horizon shows good similarity with the Cameron Hills assemblage. A careful examination of all Nielsen's hypotypes and material of the type Shaftesbury showed a much better preserved suite but generally similar to the Cameron Hills suite. The following paired species are presented as evidence of the correlation of the basal Shaftesbury to the described Cameron Hills section:

Cameron Hills	Shaftesbury formation
Ammobaculites 60C 95-100 A	*Ammobaculites* 32-9-A
Ammobaculites sp.	*Ammobaculites* sp.
Ammobaculites 61C 0-10	*Ammobaculites* sp.
Hyperammina sp.	*Hyperammina* sp.
Haplophragmoides 60C 30-35	*Haplophragmoides* 31-286 B
Haplophragmoides linki Nauss 1947)	
Haplophragmoides 60C 130-140)	*Haplophragmoides linki* Nauss 1947
Haplophragmoides 60C 165-174)	*Haplophragmoides* 31-290E
Leptodermella sp.	*Leptodermella* sp.
Miliammina 60C 40-50	*Miliammina* 31-286 A
Miliammina 60C 165-174A)	*Miliammina* 32-14B
Miliammina 60C 105-110)	
Miliammina sp.	*Miliammina* sp.
Miliammina sp.	*Miliammina* sp.
Miliammina sp.	*Miliammina* sp.

Cameron Hills	Shaftesbury formation
Nodosinella 60C 30-40	Nodosinella 31-290B
	Proteonina sp
Proteonina 61C 70-80	Proteonina 31-290A
Tritaxia 61C 40-50	Tritaxia 30-26A
Verneuilina 60C 165-174A	Verneuilina 31-258A
Verneuilina 60C 165-174B	Verneuilina sp.

Nielsen set up two microfaunal "zones" within the Shaftesbury formation; a Gaudryina-Verneuilina zone overlain by a Miliammina-Tritaxia zone. In the Cameron Hills suites, the forms described as Haplophragmoides 60C 30-35, Nodosinella 60C 30-40, and Proteonina 60C 160-165 are comparable to forms in Nielsen's Gaudryina-Verneuilina zone. Tritaxia 61C 40-50 is similar to Tritaxia 30-24A Nielsen of Nielsen's Miliammina-Tritaxia zone but occurs stratigraphically lower than the above forms.

It is therefore suggested that the Cameron Hills section lies within Nielsen's Gaudryina-Verneuilina zone of the Shaftesbury with the possibility that Nielsen's Miliammina-Tritaxia zone is above the described Cameron Hills outcrop section or absent.

The presence of Gastroplites . . (Neogastroplites? sp.) and Oxytoma pinania indicates that the described section is below, but close, to the fish scale.

The samples from location 69C were relatively barren. Their stratigraphic position (see Fig. 2) and similarity of Miliammina 69C 10-15 A, and B, to Miliammina 380A Trollope (1951) suggest they lie within the Loon River formation. The total range of Miliammina 380A is unknown and until additional species are obtained the Loon River

assignment is tentative only.

Correlation with North-Eastern British Columbia (Stelck, 1950)

Nielsen (1950) has shown good evidence for the correlation of the type Shaftesbury below the fish scale zone and the upper part of the Buckinghorse formation. The following paired species are common to the Cameron Hills section and the Buckinghorse formation:

Cameron Hills	Buckinghorse Formation
Eggerella 61C 30-40	Verneuilina? 8-227B
Proteonina 60C 110-120	Proteonina 8-279 A
Proteonina 60C 160-165	Proteonina 8-304 D
Ammobaculites 60C 160-165	Ammobaculites 8-277A

On the basis of the above paired species, the upper part of the Buckinghorse formation is correlated to the described Cameron Hills section.

Correlation with the Athabasca River Area, North Central Alberta, (Bahan, 1951)

The Labiche shale overlies the Pelican sandstone. Nielsen (1950) correlates the Basal Shaftesbury to the Basal Labiche on comparison of the microfaunal suites from the Shaftesbury to the Labiche suites of Wickenden (1948).

Examination and comparison of the Cameron Hills suites and Labiche suites of Bahan (1951), using both figured and unfigured specimens has these paired species in common:

Cameron Hills	Labiche formation (basal)
Ammobaculites 60C 165-174A	Ammobaculites cf. tyrrelli
Leptodermella sp.	Leptodermella sp.
Miliammina sp.	Miliammina M 1-B-62-81
Verneuilina 60C 165-174A	Verneuilina canadensis
Verneuilina 60C 165-174 B	Verneuilina sp.

Some species from the Joli Fou formation show marked similarity to the Cameron Hills suite. These paired forms are listed:

Cameron Hills	Joli Fou Formation
Ammobaculites 60C 130-140	Ammobaculites B-72-6
Haplophragmoides linki	Haplophragmoides linki
Haplophragmoides 60C 50-55	Haplophragmoides B-72-6

Correlation with Imperial Eldorena #1 Well in the Edmonton Area

Eldorena #1 Well (Bullock 1950)

Nielsen (1950) found good comparison of microfauna in the Shaftesbury and Lloydminster shale (post-Viking) in the Eldorena #1 well. Only one species of his list of paired species is described in the Cameron Hills suite. That is Nodosinella 60C 30-40.

These paired species common to the Eldorena #1 suites and the Cameron Hills suites are the result of an examination of the Eldorena #1 suites. The following pairs from the Basal member of the Lloydminster shale below the Eldorena sand and the Cameron Hills described section show close similarities:

Cameron Hills	Eldorena # 1
Proteonina 60C 160-165 A	Proteonina sp
Ammobaculites 60C 165-174	Ammobaculites sp

Within the Joli Fou formation these paired species were found:

Cameron Hills	Eldorena # 1
Ammobaculites 60C 100-105	Ammobaculites sp
Haplophragmoides linki Nauss	Haplophragmoides linki Nauss
Haplophragmoides 60C 30-35	Haplophragmoides sp.
Haplophragmoides 60C 140-150	Haplophragmoides sp.

The Viking zone and the Cameron Hills described section presents these paired species:

Cameron Hills	Eldorena # 1
Leptodermella sp.	Leptodermella sp.
Miliammina sp.	Miliammina sp.
Nodosinella 60C 30-40	Nodosinella sp.

Post-Viking shales and the Cameron Hills described section have these pairs in common:

Cameron Hills	Eldorena #1
Ammobaculites 60C 95-100	Ammobaculites sp.
Nodosinella 60C 30-40	Nodosinella sp.
Trochammina 60C 165-174	Trochammina sp.

The comparison of species in the shales below the Lloydminster shale (Post-Viking) suggests that certain species of these horizons extend up into the Shaftesbury equivalent in the Cameron Hills section.

Correlation with the Vermilion Area (Nauss, 1947)

Nielsen (1950) has correlated that part of the type Shaftesbury below the fish scale zone of the Lower Cretaceous of the Peace River area with that part of the Lloydminster shale above the Haplophragmoides gigas fauna and below the Globigerina loetterli zone.

Examination of Nauss's paratypes yielded these paired species of this zone and the Cameron Hills section:

Cameron Hills	Vermilion Area
Ammobaculites 60C 165-174	Ammobaculites tyrrelli Nauss
Ammobaculites 60C 95-100 A	Ammobaculites humei Nauss
Ammobaculites 60C 130-140 C	
Haplophragmoides linki Nauss	Haplophragmoides linki Nauss

The Manville formation has these forms common with the Cameron Hills section:

Cameron Hills	Vermilion Area
Haplophragmoides gigas minor Nauss	Haplophragmoides gigas minor Nauss
Miliammina 60C 165-174	Miliammina sproulei Nauss

Miliammina 32-14B Neilsen (1950) from the type Shaftesbury is not unlike M. sproulei or M. 60C 165-174.

The presence of Haplophragmoides gigas minor and Miliammina cf sproulei (M. 60C 165-174) in the Cameron Hills section suggests these forms are longer ranging in the North than in the Vermilion area.

Ammobaculites humei, Ammobaculites tyrrelli and Haplophragmoides linki all occur within the Haplophragmoides gigas fauna. Therefore the writer hesitates in following Nielsen's correlation and correlates part of the Basal Lloydminster shale of the Vermilion area to the described Cameron Hills section.

Stratigraphic Significance

The described Cameron Hills section overlies approximately 500 feet of Lower Cretaceous shales. In the Bistcho Lake well it is found that this section is a continuous shale sequence with the possibility of the Bluesky horizon being present 50 feet above the Devonian. It is possible that part or all of this lower section is equivalent to the Loon River formation. McLearn (1918, p. 15) reports 400 feet (estimated) of Loon River at Fort Vermilion and 1100 feet in the oil wells to the south (T p. 85 rge 20, W 5th mer).

The questions arise "Why does the Loon River formation thin to the North? What happens to the sand sequences that are found further south?" and "Why are some Joli Fou species found in the described Cameron Hills section when microfaunal studies indicate that it is Basal Shaftesbury or Basal Labiche formation equivalent?"

To answer these questions the writer suggests that the Cameron Hills area began to rise during the latter part of Loon River time and remained high during the deposition of the Grand Rapids formation and its equivalents elsewhere. During post-Grand Rapids time the northern area began to subside with some of the faunas moving northward with the sea. By post-Pelican ss. time the Cameron Hills area subsided and was invaded by a wide spread Shaftesbury sea. This leaves a hiatus between the Loon River formation and the described Cameron Hills section.

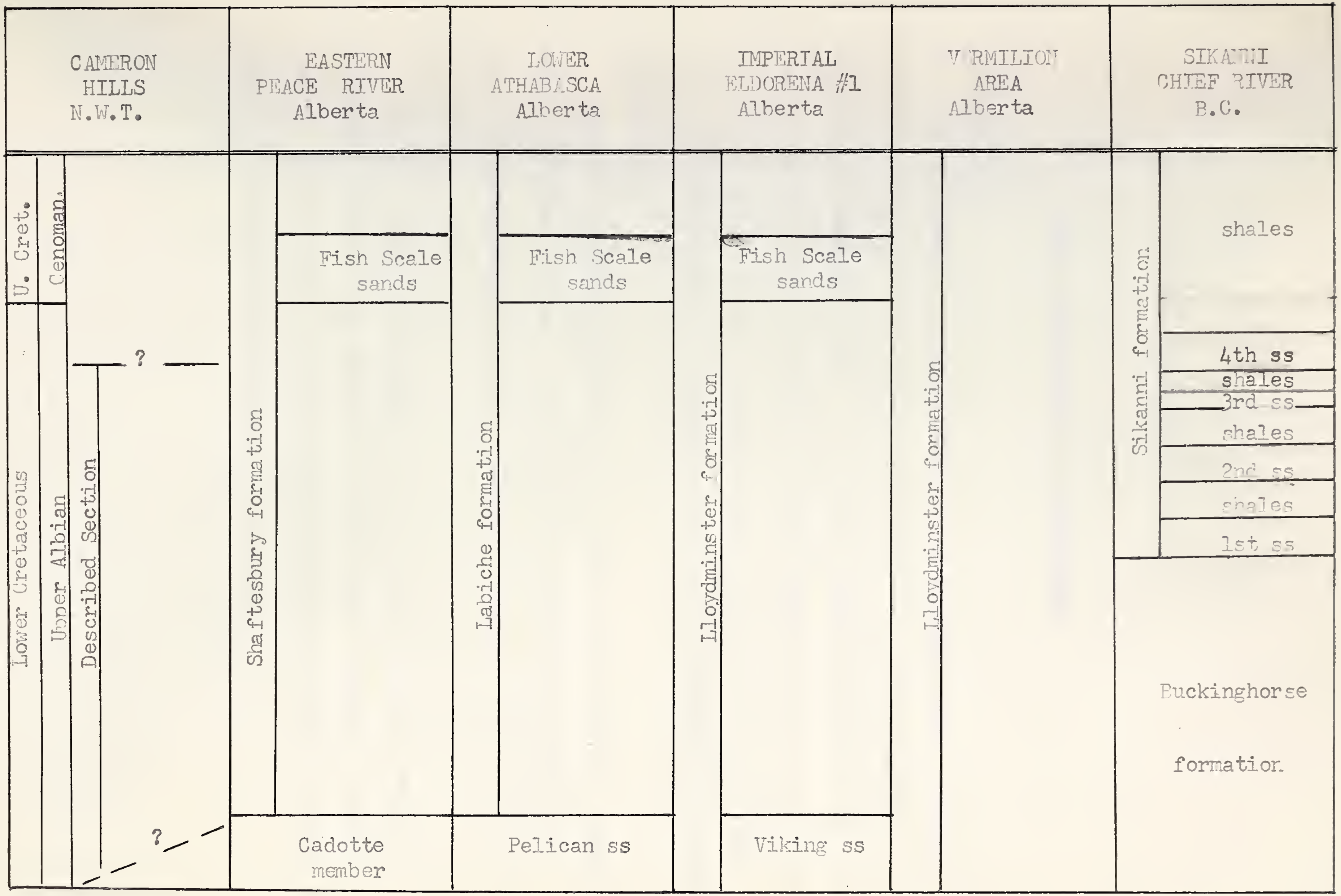


Fig. 9, Correlation Chart of the Described Cameron Hills Section and its Equivalents.

CHAPTER IV

FORMAL DESCRIPTION OF MICROFAUNA

Introduction

The microfauna described from the Cameron Hills area is almost entirely arenaceous. The fauna is generally a poorly preserved, nondescript arenaceous fauna. It was not readily separated from the shales involved. The extraction technique might have been too rugged but out of necessity had to be used. The forms described have been selected because they are diagnostic and are not necessarily dominant in the fauna.

Specific names have been avoided except where forms were undoubtedly a definite species. New species are designated by numbers to avoid creating manuscript names. These new species will be given names in event of publication.

All the described microfauna are from representative samples and were collected from the top of outcrop (zero footage) to water level. The "C" number denotes location followed by footage numbers. The fauna is described in alphabetical sequence.

Phylum PROTOZOA

Order FORAMINIFERA

Genus AMMOBACULITES Cushman, 1910

Ammobaculites 60C 130-140 A

Plate 1, Figure 2

Test elongate, subcylindrical, early portion closely coiled, involute, later portion in a straight expanding uniserial series, four chambers visible in coiled portion, four in straight series, sutures impressed throughout, distinct in coiled portion normal to long axis of test; wall rough, arenaceous with sand grains up to 0.20 mm. in size set in much cement; aperture, terminal.

Length of hypotype 0.56 mm., diameter of coiled portion 0.2 mm., length of ultimate chamber 0.18 mm., width of ultimate chamber 0.23 mm.

Hypotype Locality: Cameron R., 174' outcrop 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species shows some relationship to Ammobaculites tyrrelli Nauss 1947 but is subcylindrical in cross section rather than circular. The chambers in A. 130-140 expand in size more rapidly than A. tyrrelli Nauss.

Ammobaculites 60C 165-174 A

Plate 1, Figure 5

Test pyritized, elongate, early portion closely coiled, involute, later portion in a straight slightly expanding uniserial series, four chambers visible in coiled portion, three visible in straight series,

ultimate chamber pyriform in shape; sutures distinct and impressed throughout test, nearly at right angles to long axis in straight portion; wall arenaceous with fine sand grains cemented by siliceous cement; aperture simple ellipical, terminal.

Length of Hypotype 0.51 mm., diameter of coiled portion 0.20 mm., length of ultimate chamber of 0.21 mm., width of ultimate chamber 0.15 mm.

Hypotype Locality: Cameron R., 174' outcrop 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species bears similarity to Ammobaculites coprolithiformis (Schwager) Cushman 1946 and to A. tyrrelli Nauss 1947 but is much smaller, has a more offset coiled portion and a pyriform ultimate chamber. It is very similar to A. tyrrelli var. At Bahan, 1951 but does not appear to have as much cement. Bahan's species has only three chambers visible in the coiled portion.

Ammobaculites 60C 100-105A

Plate 1, Figure 7

Test elongate, compressed, early portion closely coiled, involute, later portion in a straight slightly expanded uniserial series, chambers in coiled portion not distinguishable, five chambers visible in straight series; sutures obscured in coiled portion, fairly distinct in straight series; wall arenaceous with sand grains up to 0.05 mm. in size generally obscured by much siliceous cement; aperture, terminal.

Length of hypotype 0.90 mm., diameter of coiled portion 0.17 mm., length of ultimate chamber 0.27 mm., width of ultimate chamber 0.27 mm.,

Hypotype locality: Cameron R., 174' outcrop 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species shows relationship to Ammobaculites 60C 105-110 and A. 61C 0-10 but coiled portion is smaller than both other species. The ultimate chamber of A. 60C 105-110 is more pyriform in shape and the ratio of width of chambers to height is greater than A. 60C 100-105 A. A. 61C 0-10 has appreciable more cement in wall than A. 61C 0-10.

Ammobaculites 60C 105-110

Plate 1, Figure 8

Test elongate, compressed, early portion tightly coiled, involute, later portion is straight slightly expanding uniserial series, chambers are not visible in coiled portion, four chambers visible in uniserial series, first chamber of uniserial series wider than coiled portion, ultimate chamber pyriform in shape; sutures not distinguishable in coiled portion, impressed in straight portion, at right angles to long axis of test in uniserial series; wall arenaceous with grains up to 0.8 mm. in size, with much cement often obscuring edges of sand grains; aperture, terminal.

Length of hypotype 0.90 mm., diameter of coiled portion 0.17 mm., length of ultimate chamber 0.35 mm., width of ultimate chamber 0.30 mm.

Hypotype locality: Cameron R., 174' outcrop 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species shows similarity to Ammobaculites 60C 100-105 A and A. 61C 0-10. For differences see the remarks of the above.

Ammobaculites 60C 165-174 B

Plate 1, Figure 9

Test elongate; early portion closely coiled with four chambers visible, later portion in a straight uniserial pattern, slightly expanding chambers, four chambers are present; ultimate chamber ovate in section, pyriform in shape, considerably larger than penultimate chamber; sutures throughout are impressed and somewhat indistinct; wall arenaceous with much cement obscuring individual sand grains, has shrunken appearance; aperture simple and terminal.

Length of hypotype 0.70 mm., diameter of coiled portion 0.17 mm., length of ultimate chamber 0.26 mm., width of ultimate chamber 0.18 mm.

Hypotype locality: Cameron R., 174' outcrop 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This shows some relationship to Ammobaculites coprolithiformis (Schwager) Cushman, 1946 but is much smaller and has a more elongate ultimate chamber. It is also similar to A. 60C 95-100 but has four chambers visible in coiled portion and appears to have more cement and a somewhat shrunken appearance. It also shows a very marked similarity to Ammobaculites euides Loeblich and Tappan, 1949.

Ammobaculites 60C 30-35

Plate 1, Figure 10, 11

Test elongate, delicate, early portion closely coiled, involute, later portion in a straight uniserial series, four chambers visible in coiled portion, two chambers present in straight series, ultimate chamber almost round in shape; sutures impressed and distinct throughout test;

wall fragile, arenaceous, with siliceous cement obscuring edges of most sand grains; aperture slit, terminal.

Length of hypotype 0.43 mm., diameter of coiled portion 0.20 mm., length of ultimate chamber 0.20 mm., width of ultimate chamber 0.23 mm.

Hypotype locality: Cameron R., 174' outcrop 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Ammobaculites 60C 130-140 B

Plate 1, Figure 12

Test elongate, ovate, early portion closely coiled involute, later portion in a straight uniserial series, four chambers visible in coiled portion, three chambers in straight series, ultimate chamber ovate, subpyriform in shape; sutures fairly distinct throughout, flush but have appearance of being impressed due to much cement in coiled and early portion of straight series, impressed between penultimate and ultimate chamber, slightly off normal to long axis; wall arenaceous with coarse sand grains well obscured by much cement up to 0.07 mm. in size in coiled portion and early part of straight series, ultimate chamber made up of finer sand grains obscured by much cement; aperture terminal with a suggestion of an incipient neck.

Length of hypotype 0.75 mm., diameter of coiled portion 0.25 mm., length of ultimate chamber 0.26 mm., width of ultimate chamber 0.11 mm.

Hypotype locality: Cameron R., 174' outcrop 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This form is similar to Ammobaculites B-72-6, Bahan 1951, found 47' above Grand Rapids formation. It is however smaller and shows a distinct change of the character of the wall in the last two chambers of the straight series from that of the coiled portion and first chamber of the straight series. Ammobaculites B-72-6 is coarsely arenaceous throughout test.

Ammobaculites 60C 130-140 C

Plate 1, Figure 13

Test elongate, early portion closely coiled, partially evolute, later portion in a straight, slightly expanding uniserial series, three chambers visible in outer whorl of coiled portion, one and possibly one-half chambers missing, five chambers visible in straight series, early chambers of straight series ovate, penultimate and ultimate chambers compressed; sutures impressed and distinct throughout test at right angles to long axis of test; wall arenaceous with sand grains set in much siliceous cement obscuring edges of most sand grains, aperture terminal.

Length of hypotype 0.90 mm., diameter of coiled portion 0.25 mm., length of ultimate chamber 0.30 mm., width of ultimate chamber 0.23 mm.

Hypotype locality: Cameron R., 174' outcrop 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species bears some similarity to Ammobaculites humei Nauss 1947 and to the A. humei Nauss of Martin 1954 but ultimate chamber is longer compared to width and coiled portion appears to be partially evolute.

[illegible]

Ammobaculites 60C 95-100 A

Plate 1, Figure 18

Test elongate, straight, early portion closely coiled with three chambers visible, later portion in a straight slightly expanding uniserial series, five chambers visible in straight series, ultimate chamber rounded pyriform in shape; sutures fairly indistinct in coiled portion, distinct and impressed in straight portion, at right angles to long axis of test in uniserial series; wall arenaceous with grains up to 0.05 mm. in size with much cement often obscuring edges of sand grains; aperture simple and terminal.

Length of hypotype 0.81 mm., diameter of coiled portion 0.20 mm., length of ultimate chamber 0.25 mm., width of ultimate chamber 0.19 mm.

Hypotype Locality: Cameron R., 174' outcrop 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species almost identical to Ammobaculites 32-9-A Nielsen 1950 (undescribed specimen) and shows marked similarity to Ammobaculites 31-264-A Nielsen 1950 from the lower part of the Shaftesbury formation. It is somewhat similar to A. coprolithiformis (Schwager) Cushman 1946, plate 3, figure 8, but is smaller and has a pyriform shaped ultimate chamber. A. humei Nauss 1947 from the Manville formation and Lloydminster shale show close relationship but A. 60C 95-100 has more uniform size chambers in the uniserial portion than A. humei. A. tyrrelli Nauss 1947 from the Lloydminster shale is similar but A. 60C 95-100 has three chambers visible in coiled portion and has a pyriform ultimate chamber as compared to four chambers visible in coiled portion of A. tyrrelli.

Ammobaculites 60C 100-105 B

Plate 1, Figure 19

Test elongate, early portion closely irregularily coiled in a slight trochoid fashion, involute, later portion consists of one chamber of a straight uniserial series, five chambers visible in coiled portion, sutures very slightly impressed in coiled portion, impressed between coiled and straight series; wall, arenaceous with sand grains generally obscured in much siliceous cement; aperture simple, terminal.

Length of hypotype 0.47 mm., long diameter of coiled portion 0.27 mm.

Hypotype locality: Cameron R., 174' outcrop 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Ammobaculites 60C 160-165

Plate 1, Figure 20

Test elongate, slightly compressed, early portion closely coiled, involute later portion in a straight uniserial series, three chambers in coiled portion, three equally developed chambers in uniserial portion; sutures impressed, indistinct in coiled portion, distinct in uniserial portion; wall coarsely arenaceous, sand grains up to 0.05 mm. in size in much cement and are nearly obscured; aperture terminal.

Length of hypotype 0.65 mm., diameter of coiled portion 0.23 mm.

Hypotype Locality: Cameron R., 174' outcrop 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species shows marked similarity to Ammobaculites 8-227 A Stelck 1950 from the upper part of the Buckinghorse formation.

Ammobaculites 60C 95-100B

Plate 1, Figure 21

Test elongate, compressed, early portion closely coiled involute, later portion in straight uniserial series, chambers in coiled portion not distinguishable, two visible in straight series, ultimate chamber subpyriform in shape; sutures obscured in coiled portion, impressed in straight series; wall arenaceous with sand grains up to 0.02 mm. in size set in much cement generally obscuring edges of sand grains; aperture terminal.

Length of hypotype 0.69 mm., diameter of coiled portion 0.29 mm., length of ultimate chamber 0.33 mm., width of ultimate chambers 0.29 mm.

Hypotype locality: Cameron R., 174' outcrop 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species is very similar to the hypotype and paratypes of Martin's (1954) *Ammobaculites humei* Nauss 1947. *A.* 60C 95-100B has only two chambers in the straight series.

Ammobaculites 60C 155-160

Plate 1, Figure 22, 23

Test elongate, early portion coiled, involute, later portion a straight slightly expanding uniserial series, five chambers visible in coiled portion, four chambers visible in uniserial series, becoming ovate in penultimate and ultimate chambers with long axis normal to plane of coiling in coiled portion, ultimate chamber pyriform in shape; sutures distinct and impressed throughout, normal to long axis of test

in straight portion; wall arenaceous with much cement obscuring edges of individual sand grains; aperture terminal, elliptical and simple.

Length of hypotype 0.54 mm., diameter of coiled portion 0.20 mm. length of ultimate chamber 0.28 mm., widths of ultimate chamber 0.15 mm. and 0.23 mm.

Hypotype locality: Cameron R., 174' outcrop 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

<u>Ammobaculites</u> 61C 0-10

Plate 3, Figure 16

Test elongate, early portion closely coiled, involute, later portion in a slightly expanding straight uniserial series, four chambers visible in coiled portion, six chambers visible in straight series, ultimate chamber subpyriform in shape; sutures impressed and more distinct in straight portion; wall, arenaceous with sand grains up to 0.05 mm. in size set in a matrix of much siliceous cement obscuring most of the individual sand grains; aperture terminal, simple.

Length of hypotype 1.19 mm., diameter of coiled portion 0.20 mm., length of ultimate chamber 0.31 mm., width of ultimate chamber 0.30 mm.

Hypotype locality: Cameron R., 88' outcrop 11½ miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species resembles <u>Ammobaculites</u> 60C 105-110 and <u>A.</u> 60C 100-105A. It has more cement in the walls and the coiled portion is greater in size in proportion to the first formed chamber of the straight series. The sutures are more distinct in the coiled portion than in the above species.

Genus <u>AMMODISCUS</u> Reuss, 1861

<u>Ammodiscus</u> 60C 160-165

Plate 2, Figure 9

Test pyritized, discoidal, compressed, an irregular planispiral coil, periphery sharply rounded; proloculum somewhat obscured, tubular second chamber gradually increasing in size, occasionally overlapping the preceding coil; wall arenaceous, fine grained with small amount of cement, thin; aperture open end of the tubular chamber.

Maximum diameter of hypotype 0.37 mm., minimum diameter of hypotype 0.27 mm.

Hypotype locality: Cameron R. 174' outcrop, 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species is similar to <u>Ammodiscus</u> 2-1-12 Bahan 1951 but appears to have more overlapping of chambers on preceding whorls.

Genus <u>EGGERELLA</u> Cushman, 1933

<u>Eggerella</u> 60C 45-50

Plate 2, Figure 18, 19

Test an elongate trochoid spire, tapering out gradually from initial end to greatest breadth near apertural end; chambers numerous, only very slightly inflated, four to a whorl for the half the length then three in a whorl, two chambers of ultimate whorl appear somewhat compressed, sutures somewhat indistinct and impressed; wall arenaceous with fine sand grains obscured by much cement yielding a somewhat smooth

surface; aperture partially obscured but an opening at the inner margin of the last formed chamber.

Length of hypotype 0.38 mm., maximum breadth of hypotype 0.20 mm.

Hypotype locality: Cameron R., 174' outcrop, 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species is similar to Eggerella Z-7-56A Martin 1954 but tightly coiled portion in ratio to upper coils is one to five as compared to one to three in Martin's species.

Eggerella 61C 30-40

Plate 3, Figure 5

Test an elongate trochoid spire, tapering out gradually from initial end to greatest breadth near apertural end; chambers numerous, slightly inflated, four to whorl for the most part, three in ultimate whorl, gradually increasing in size as added, ultimate chamber damaged in fossilization; sutures, distinct, slightly impressed; wall arenaceous with fine sand grains obscured in much cement yielding somewhat smooth surface; aperture obscured.

Length of hypotype 0.42 mm., maximum breadth of hypotype 0.17 mm.

Hypotype Locality: Cameron R., 88' outcrop, 11½ miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species differs from Eggerella 60C 45-50 as chambers are more inflated, sutures more distinct and a more regular coiled appearance. The last whorl has chambers more inflated as compared to previous whorls.

This species is very similar to the quadriserial Verneuilina? 8-227B Stelck 1950 found 227' below the top of the First Sikanni sandstone in the Buckinghorse formation.

Genus HAPLOPHRAGMOIDES Cushman, 1910

Haplophragmoides 60C 30-35

Plate 1, Figure 14, 15

Test small, robust, planispiral involute, periphery broadly rounded, umbilical area broadest portion, chambers very slightly inflated, five and one-half chambers visible; sutures distinct and somewhat impressed but appear more so due to thickening of intercameral walls; wall arenaceous with fine sand grains obscured by siliceous cement, smooth but not glossy; aperture in doubt.

Major diameter of hypotype 0.32 mm., minor diameter of hypotype 0.22 mm., breadth of hypotype 0.17 mm.

Hypotype locality: Cameron R., 174' outcrop, 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This form is very similar to Haplophragmoides 31-286B Nielsen, 1950 of the Lower Shaftesbury but chambers are not as inflated. It does however appear to have a close affinity to it. It is also similar to H. 28-9C Stelck 1950 of the Basal Kaskapau formation but is more finely arenaceous.

Haplophragmoides linki Nauss

Plate 1, Figure 16, 17

Synonymy:

Haplophragmoides rugosa Cushman 1927, Royal Soc. Proc. and Trans., vol. 21, sec. 4, page 128, pl. 1, figure 2.

Haplophragmoides linki Nauss, 1947. Jour. of Paleontology, Vol. 21, no. 4, p. 339, pl. 49, figure 7a, 7b.

Test small, planispiral, involute becoming evolute, umbilical area depressed, periphery rounded; chambers, inflated, globular, seven in ultimate whorl, ultimate chamber slightly compressed in fossilization; sutures curving gently back, distinct, radial, depressed; wall arenaceous with fine sand grains in much cement yielding a fairly smooth surface; aperture at base of apertural face of ultimate chamber.

Major diameter of hypotype 0.33 mm., minor diameter of hypotype 0.30 mm., breadth of ultimate chamber 0.11 mm.

Hypotype locality: Cameron R., 174' outcrop 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This form is almost identical but has a slightly more lobate periphery than Haplophragmoides linki Nauss of Bahan 1951 found 22' above the top of the Grand Rapids formation. In the Vermilion area (Nauss 1947) it is found in the lower part of the Lloydminster shale. This species is present in the basal 100' of the Shaftesbury formation.

<u>Haplophragmoides</u> 60C 130-140

Plate 2, Figure 1,2

Test pyritized, medium size, somewhat compressed, planispiral, partially involute becoming evolute, umbilical area depressed, obscured, periphery sharply rounded; chambers slightly inflated six and two half chambers in ultimate whorl, ultimate chamber incomplete; sutures depressed, distinct, somewhat thickened, straight and gently curving back, radial; wall arenaceous with fine sand grains abscured in much cement yielding a fairly smooth surface; aperture in doubt.

Major diameter of hypotype 0.41 mm., minor diameter of hypotype 0.28, breadth of hypotype 0.10 mm.

Hypotype Locality: Cameron R., 174' outcrop, 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This form has close affinity to <u>Haplophragmoides</u> 60C 165-174 and <u>H</u>. <u>linki</u> Nauss 1947. It is relatively thinner in cross-section than <u>H</u>. <u>linki</u> Nauss and sutures have not as much tendency to be arcuate as in <u>H</u>. 60C 165-174. It might well be conspecific with <u>H</u>. 60C 165-174. It also has a very close affinity to <u>H</u>. 30-290E Nielsen 1950 and might well be same species.

<u>Haplophragmoides</u> 60C 50-55

Plate 2, Figure 3, 4

Test large, slightly compressed, planispiral, involute, periphery sharply rounded, umbilical area thickest portion, five chambers visible in ultimate whorl; sutures indistinct but emphasized due to strength of intercameral walls, straight radial; wall arenaceous with sand grains

up to 0.07 mm. in size generally aligned along suture, chamber walls generally finer grained, obscured in siliceous cement; aperture, narrow slit at base of apertural face of ultimate chamber.

Major diameter of hypotype 0.57 mm., minor diameter of hypotype 0.40 mm., breadth of hypotype 0.15 mm.

Hypotype locality: Cameron R., 174' outcrop, 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species is very similar to Haplophragmoides B-72-6 Bahan 1951 found 63' below top of Joli Fou shale and 47' above top of the Grand Rapids formation. The wall structure is less coursely arenaceous and slightly compressed. It also compares favorably with H. M6-B Mellon 1954 but the coarse wall texture of H. M6-B masks diagnostic features of that form.

Haplophragmoides 60C 165-174

Plate 2, Figure 5

Test pyritized, small, somewhat compressed, planispiral, partially evolute umbilical area somewhat depressed, partly obscured, periphery gently rounded except on last three chambers of ultimate whorl which have been compressed on preservation, eight chambers visible in ultimate whorl; sutures somewhat depressed but appear more so due to thickening of intercameral walls, slightly arcuate, radial; wall arenaceous with fine sand grains in matrix of siliceous cement, obscuring individual sand grains; aperture not observed.

Major diameter of hypotype 0.35 mm., minor diameter of hypotype 0.28 mm.

Hypotype locality: Cameron R. 174' outcrop, 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This form has been distorted slightly by compression but has close affinity to Haplophragmoides 60C 130-140 but sutures have a tendency to be slightly arcuate. It is relatively thinner in cross section but very similar to H. linki Nauss 1947. It might well be conspecific to both above. It also has very close affinity to Haplophragmoides 31-290-E Nielsen 1950 which is found in the Shaftesbury formation, 290' below the "fish scales". It is similar even to the slightly arcuate sutures of one of the paratypes.

Haplophragmoides 60C 140-150

Plate 2, Figure 6

Test medium size, compressed, planispiral, close coiled involute becoming evolute, umbilical area depressed, periphery narrowly rounded; chambers flattening towards periphery, very slightly inflated toward umbilical area, nine visible in ultimate whorl; sutures slightly depressed, fairly distinct, straight and curving gently back, radial; wall arenaceous with fine grains obscured in much cement yielding a fairly smooth surface; aperture in doubt.

Major diameter of hypotype 0.45 mm., minor diameter of hypotype 0.30 mm.

Hypotype locality: Cameron R., 174' outcrop 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Haplophragmoides 61C 0-10

Plate 3, Figure 17, 18

Test medium size, somewhat compressed, planispiral partially evolute, umbilical area depressed, partly obscured, chambers depressed near periphery, nine visible in ultimate whorl; sutures, thickened intercameral walls give appearance of sutures being depressed, straight, radial; wall arenaceous with fine sand grains obscured in much siliceous cement yielding a fairly smooth surface; aperture in doubt.

Major diameter ofhypotype 0.52 mm., minor diameter of hypotype 0.35 mm., breadth of hypotype 0.07 mm.

Hypotype locality: Cameron R., 88' outcrop, $11\frac{1}{2}$ miles straight south of south shore of Tathlina Lake, N. W. T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species is similar to Haplophragmoides gigas minor Nauss 1947 in appearance of side view but is much thinner in cross section.

Genus LEPTODERMELLA Rhumbler, 1935

Leptodermella 69C 10-15

Plate 3, Figure 6, 7

Test compressed, would be plano-convex before compression, now circular in outline with a raised rounded ridge around border; wall arenaceous with much siliceous cement obscuring sand grains; aperture simple, somewhat depressed in center of compressed convex ventral face; color buff.

Diameter of hypotype 0.27 mm., diameter of aperture 0.03 mm.

Hypotype locality: An unnamed stream 23' outcrop in close proximity to the 6th Meridian 3 3/4 miles south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species is quite abundant in this horizon making up approximately 14% of fauna.

Genus MILIAMMINA Heron-Allen and Earland, 1950

Miliammina 60C 150-155

Plate 2, Figure 7, 8

Test, robust, almost circular in outline, rounded triangular in transverse section; chambers inflated, elongate, tubular, each half a turn in length, in quinqueloculine arrangement, four visible on one side, three on the other, ultimate chamber swollen and almost one half the volume of the test, sutures somewhat obscured, depressed; wall arenaceous with fine sand grains obscured in much siliceous cement yielding a fairly smooth surface; aperture terminal, simple on a short neck of the last formed chamber that projects slightly over previous chambers; color light buff.

Length of hypotype 0.42 mm., width of hypotype 0.27 mm.

Hypotype Locality: Cameron R, 174' outcrop, 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Miliammina 60C 165-174 A

Plate 2, Figure 10, 11

Test elongate, elliptical in outline and transverse section; chambers distinct, elongate, tubular, each half a turn in length, in irregular quinqueloculine arrangement but with four chambers visible on either side; sutures distinct, slightly depressed; wall arenaceous with fine sand grains obscured in considerable cement yielding a somewhat smooth surface; aperture terminal, distinct the open end of the last formed chamber; color light buff.

Length of hypotype 0.50 mm., width of hypotype 0.19 mm.

Hypotype locality: Cameron R., 174' outcrop, 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species is very similar to Miliammina sproulei gigantea Mellon and Wall 1956 but sutures are not as impressed in M 60C 165-174A. It is also very similar to Miliammina sproulei Nauss 1947 from the Cummings Member and from the top of the Grand Rapids formation in Bahan's suite.

It is similar to M. 60C 105-110 but is a flatter form than M. 60C 105-110. It is also very similar to M. 32-14-B Nielsen, 1950, but much smaller and impressed sutures have less cement covering them than in M. 32-14-B.

Miliammina 60C 165-174B

Plate 2, Figure 12, 13

Test elongate, compressed; chambers compressed in fossilization, elongate, each half a turn in length, in triloculine arrangement in early portion, last two chambers appear to be in single plane, overlapping; sutures, fairly distinct, slightly depressed; wall arenaceous, thin,

moderate amount of cement; aperture obscured but at open end of last formed chamber; color dark gray.

Length of hypotype 0.50 mm., width of hypotype 0.20 mm.

Hypotype locality: Cameron R., 174' outcrop, 14 miles straight south of south shore of Tathlina Lake, N. W. T.

Hypotype: University of Alberta Palaeontological Type Collection.

Miliammina 60C 45-50

Plate 2, Figure 14, 15.

Test elongate, elliptical in outline, robust, well rounded triangular in transverse section; chambers elongate, tubular, inflated, overlapping, each half turn in length, ultimate chamber almost one-half the size of test, in triloculine arrangement, three visible on one side, two on the other; sutures fairly distinct, depressed; wall arenaceous with fine sand grains obscured by considerable siliceous cement yielding a fairly smooth surface; aperture terminal, simple, on a short neck which projects beyond the second last chamber; color white with dark buff neck.

Length of hypotypes 0.78 mm., width of hypotypes 0.28 mm.

Hypotype locality: Cameron R., 174' outcrop, 14 miles straight south of south shore of Tathlina Lake, N. W. T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species is similar to Miliammina 31-286A Nielsen 1950 in triloculine arrangement of chambers and robust appearance but is more rounded in transverse section and the length of test is longer with respect to width than M. 31-286A.

<u>Miliammina</u> 60C 105-110

Plate 2, Figure 16, 17

Test elongate, elliptical, roughly rounded triangular in transverse section; chambers elongate, tubular, each half a turn in length, in quinqueloculine arrangement, three visible on one side, four on the other; sutures distinct, slightly depressed; wall arenaceous with fine sand grains obscured by considerable siliceous cement yielding a fairly smooth surface; aperture terminal, indistinct, the open end of the last formed chamber which projects very slightly beyond previous chambers; color white.

Length of hypotype 0.42 mm., width of hypotype 0.19 mm.

Hypotype locality: Cameron R., 174' outcrop, 14 miles straight south of south shore of Tathlina Lake, N. W. T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species is similar to <u>Miliammina</u> 32-14B Nielsen in quinqueloculine arrangement of chambers but is a more rounded triangular form.

It is similar to <u>Miliammina</u> <u>sproulei</u> Nauss 1947 from the Cummings member but is not as elongate with respect to width as <u>M.</u> <u>sproulei</u>.

<u>Miliammina</u> 69C 10-15B

Plate 3, Figure 13

Test subelongate, elliptical in outline, flat in transverse section, chambers, numerous elongate, tubular, each half a turn in length in single plane, somewhat overlapping on one side; sutures somewhat obscure, very slightly depressed but appear more so due to darker coloring; wall arenaceous with fine sands obscured by considerable cement yielding a somewhat smooth surface; aperture terminal, the open end of the last formed chamber.

Length of hypotype 0.40 mm., width of hypotype 0.28 mm.

Hypotype locality: On unnamed stream, 23' outcrop, in close proximity to the Sixth Meridian, 3 3/4 miles south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species, very closely resembles <u>Miliammina</u> 380A Trollope 1951 and Miliammina 30-31A Nielsen 1950. All three forms do appear to have a very close affinity.

It also resembles <u>M</u>. 69C 10-15A but is wider with respect to length.

<u>Miliammina</u> 69C 10-15A

Plate 3, Figure 14, 15

Test elongate, elliptical compressed flat in transverse section; chambers elongate, tubular, each half a turn in length, in one plane, overlapping, outer ones distinct, inner ones obscure; sutures, outer ones distinct, slightly impressed, inner ones obscured; wall arenaceous

with fine sand grains obscured by considerable siliceous cement yielding a fairly smooth surface; aperture distinct, the open end of the last formed chamber that projects very slightly beyond previous chamber, suggestion of phialine lip; color outer chamber white, inner chambers darker.

Length of hypotype 0.58 mm., width of hypotype 0.25 mm.

Hypotype locality: On unnamed stream, 23' outcrop, in close proximity to the Sixth Meridian, 3 3/4 miles south of south shore of Tathlina Lake, N. W. T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species compares very well with paratypes of *Miliammina* 380A Trollope 1951 and *Miliammina* 30-31A Nielsen 1950. All three forms appear to have a close affinity.

It resembles *M.* 69C 10-15B but is longer with respect to width. It might be conspecific with *M.* 69C 10-15B. *M.* 5-21-4 Howard and Moffet 1954 is similar but is wider with respect to length and sutures are not as distinct as in *M.* 69C 10-15A.

Genus *NODOSINELLA* H. B. Brady, 1876

Nodosinella 60C 35-40

Plate 1, Figure 4.

Test compressed, tapering from maximum width one third the length from apertural end, apertural end of ultimate chamber not compressed, elliptical in cross-section; chambers arranged in a straight expanding uniserial series, four in number, ultimate chamber one-half the length of entire test; sutures impressed and fairly distinct, at right angles to long axis of test; wall arenaceous, smooth, with much white siliceous cement obscuring individual sand grains; aperture simple, terminal.

Length of hypotype 0.45 mm., width of hypotype 0.30 mm.

Hypotype locality: Cameron R., 174' outcrop, 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species appears to be the same species as Nodosinella 31-290-B Nielsen 1950, but has been compressed more on fossilization.

Genus PROTEONINA Williamson, 1858

Proteonina 60C 160-165 B

Plate 1, Figure 1

Test a single sub-elliptical shaped chamber with a straight tubular neck, maximum diameter of the short axis one-half of the length from the aperture; wall fairly thick, with chamber covered by coarse sand grains; set in a matrix of finely arenaceous cement, sand grains covering chamber up to 0.08 mm. in size, neck is smoother with more cement obscuring the outline of finer sand grains in that portion of the wall; aperture terminal and simple.

Length of hypotype 0.53 mm., maximum width 0.28 mm.

Hypotype Locality: Cameron R., 174' outcrop, 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species is similar to Proteonina 30-142A Nielsen 1950 but the wall make up appears to be thinner, of smaller grain size. The chamber of P. 60C 160-165B tapers more on both ends than the P. 30-142A.

<u>Proteonina</u> 60C 110-120

Plate 1, Figure 3

Test a single "milk bottle" shaped cylindrical chamber, with a slightly tapering tubular neck, maximum diameter of chamber three quarters of the length from the aperture; wall fairly thick with arenaceous cement obscuring most of the sand grains which range up to 0.01 mm. in size, neck differentiated by fine sand grains set in less amount of arenaceous cement and change in color; aperture terminal; color, chamber yellow, neck buff.

Length of hypotype 0.43 mm., maximum width 0.15 mm.

Hypotype locality: Cameron R., 174' outcrop, 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species is similar in general shape to <u>Proteonina</u> 8-279A Stelck 1951 found in the Buckinghorse Formation, 279 feet below top of the First Sikanni sandstone, but has a much finer grained wall structure.

<u>Proteonina</u> 60C 160-165A

Plate 1, Figure 6

Test a single flask shaped chamber with a straight tubular neck, maximum diameter of test is at two thirds of the length from the aperture; wall fairly thick; chamber covered by coarse sand grains set in a matrix of finely arenaceous cement, sand grains covering chamber up to 0.13 mm. in size, neck is smoother with more cement obscuring the outline of the sand grains in that portion of the wall; aperture terminal and simple.

Length of hypotype 0.50 mm., maximum width 0.33 mm.

Hypotype locality: Cameron R., 174' outcrop, 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This form is similar to Proteonina 8-504D illustrated, by Stelck 1951 from the Buckinghorse Formation 304' below the First Sikanni sandstone. The general flask shape is similar but the neck of P. 60C 160-165A does not taper as much. Make up of the wall appears to be similar.

This is without doubt the same species as P. 31-290A Nielsen 1950 found 290' below the fish scale zone in the Shaftesbury Formation.

It is also similar to P. 61C 70-80 but the later is finer grained, more rounded and has a longer neck.

Proteonina 61C 70-80

Plate 3, Figure 12

Test a simple oval shaped chamber with a straight tubular neck at an oblique angle to plane of test, length of neck one-third of total length, maximum diameter of test one-half the length from the aperture; wall thick, with chamber covered by fairly coarse sand grains studded in siliceous cement, sand grains covering chamber up to 0.5 mm. in size, neck is smoother with more cement obscuring the outline of the sand grains; aperture terminal.

Length of hypotype 0.45 mm., maximum width 0.33 mm.

Hypotype locality: Cameron R., 88' outcrop 11½ miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This form is similar to, but differs from Proteonina 31-290A Nielsen 1950 and P. 60C 160-165 A in its more oval shape, longer neck and finer grained wall structure.

Genus QUADRIMORPHINA Finlay, 1939

Quadrimorphina 60C 130-140

Plate 2, Figure 25, 26

Test small, trochoid in an anticlockwise spiral, biconvex, tending to be globigerinoid; a very low spire, one and one-quarter whorls and large circular proloculus; chambers increase rapidly in size, last four noticeably inflated and sub-globular, all chambers visible from dorsal side, four from ventral side; sutures distinct, depressed, umbilicus closed; wall calcareous, perforate, smooth; aperture obscured, not evident, apparently an elongate arched opening, below the border of last formed chamber on the ventral side; color, light brown with darker proloculus.

Maximum diameter of hypotype 0.28 mm.

Hypotype locality: Cameron R., 174' outcrop, 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This form is almost identical to Quandrimorphina albertensis Mellon and Wall 1956 from the Clearwater Formation. It appears to be the megalospheric form of the above.

Genus TEXTULARIA DeFrance, 1824

Textularia 61C O-10

Plate 3, Figure 1

Test almost twice as long as maximum width one third the length from the apertural end, rounded, rectangular in transverse section, biserial, chambers increasing in size toward apertural end, apertural end compressed and obscured in fossilization; sutures slightly depressed, fairly indistinct, oblique, darker in color; wall arenaceous with much siliceous cement obscuring individual sand grains; aperture obscured; color, dark buff, sutures brown.

Length of hypotype 0.40 mm., width of hypotype 0.23 mm.

Hypotype locality: Cameron R., 88' outcrop $11\frac{1}{2}$ miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species is similar to *Textularia hybrida* Chapman 1899 from the Cambridge Greensand. It is however much smaller and expands in width with respect to length more rapidly than *T. hybrida*.

Textularia 61C O-10 also shows some similarity to *T. subglabra*, Cushman 1926, but chambers are not as inflated and it does not expand in width as rapidly with respect to length as *T. subglabra*.

It might well be a link between the two species.

Genus TRITAXIA Reuss, 1860

Tritaxia 61C 60-70

Plate 3, Figure 2, 3 and 4

Test elongate, lobulate, tapering at both ends maximum breadth across ultimate chamber, triserial; chambers distinct, inflated, overlapping, increasing in size as added, initial chambers somewhat distorted on fossilization, ultimate chamber almost one-half the size of test; sutures distinct, impressed, curved; wall thick, arenaceous with fine sand grains obscured by siliceous cement, fairly smooth; aperture simple terminal at end of short neck of ultimate chamber; color white.

Length of hypotype 0.65 mm., maximum breadth of hypotype 0.35 mm.

Hypotype locality: Cameron R., 88' outcrop, 11½ miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Tritaxia 61C 40-50

Plate 3, Figures 8, 9

Test subelongate, globular, tapering slightly at either end, triserial; chambers distinct, inflated, overlapping, drawn out to a neck, increasing in size as added, initial chambers obscured or single chamber, sutures, distinct, impressed curved; wall arenaceous with fine sand grains obscured by much siliceous cement, smooth; aperture simple, terminal at end of neck of ultimate chamber; color white.

Length of hypotype 0.42 mm., maximum breadth of hypotype 0.25 mm.

Hypotype locality: Cameron R., 88' outcrop, 11½ miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species is very similar to a paratype of Tritaxia 30-26A Nielsen found 26' below the fish scale zone in the Shaftesbury Formation.

Tritaxia 69C 10-15A

Plate 3, Figure 10

Test elongate, compressed, tapering from initial end to maximum breadth across ultimate chamber, triserial; chambers, seven, distinct, compressed, overlapping, increasing in size as added ultimate chamber drawn out to a neck; sutures distinct, somewhat impressed, curved; wall arenaceous with fine sand grains obscured by much siliceous cement, relatively thin, smooth; aperture, simple, terminal at end of short neck of ultimate chamber; color white.

Length of hypotype 0.45 mm., maximum breadth of hypotype 0.17 mm.

Remarks: This form is the microspheric form of Tritaxia 69C 10-15B and found in the same suite.

Tritaxia 69C 10-15B

Plate 3, Figure 11

Megalospheric form of Tritaxia 69C 10-15A with five chambers visible.

Hypotype locality: On unnamed stream, 23' outcrop in close proximity to the Sixth Meridian, 3 3/4 miles south of the south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Genus TROCHAMMINA Parker and Jones, 1850

Trochammina 60C 165-174

Plate 2, Figures 27, 28, 29

Test compressed, periphery sharply rounded, in a flat trochoid spire with one and one-half distinct whorls, inner whorls obscured; spire low and flush with dorsal surface of ultimate whorl, but made noticeable by distinctly darker color; ventral surface uneven, umbilicus depressed and somewhat obscured; chambers gradually increasing in size, slightly compressed on ventral side, seven visible in ultimate whorl; chambers highly compressed in ventral side; sutures of ultimate whorl distinct upon wetting, oblique position accentuated by darker color and strength of intercameral walls; on ventral side, sutures stand up as ridges due to compression of chambers; wall finely arenaceous with much cement yielding a somewhat smooth surface; aperture obscured on ventral side; color amber with the spire distinctly darker than outer whorl.

Maximum diameter of hypotype 0.37 mm.

Hypotype locality: Cameron R., 174' outcrop, 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species is similar to Trochammina callima Loeblich and Tappan 1950, but differs in a smoother periphery and last whorl expands in size more rapidly with respect to inner whorls.

It differs from Trochammina M 7-A Mellon 1955 in being slightly thicker in cross section and chambers lack the scalloped appearance of Mellon's form.

Genus VERNEUILINA D'Orbigny, 1840

Verneuilina 60C 165-174A

Plate 2, Figure 20

Test pyritized, elongate, tapering out rapidly for one third of the length then gradually tapering, greatest breadth toward apertural end, triserial throughout, rounded triangular in end view, chambers, numerous, fairly distinct, inflated where not compressed in fossilization gradually increasing in size as added; sutures fairly distinct, somewhat depressed; wall arenaceous with individual sand grains being obscured in much siliceous cement yielding a somewhat smooth surface; aperture obscured but suggestion of opening at inner margin of last formed chamber.

Length of hypotype 0.47 mm., width of hypotype 0.25 mm.

Hypotype Locality: Cameron R., 174' outcrop, 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: This species is very similar to Verneuilina 31-258A Nielsen 1950, but chambers of last whorl are more inflated in V. 60C 165-174A. The forms do appear to have a very close affinity to each other.

Verneuilina 60C 130-140

Plate 2, Figure 21

Test elongate, tapering gradually to near maximum breadth almost one half the length from the apertural end then becoming almost parallel, triserial throughout, rounded triangular in end view; chambers numerous, slightly inflated increasing in size as each is added; sutures distinct, slightly depressed; wall arenaceous with much cement obscuring fine sand grains yielding a somewhat smooth surface; aperture obscured.

Length of hypotype 0.43 mm., maximum breadth of hypotype 0.20 mm.

Hypotype locality: Cameron R., 174' outcrop, 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Verneuilina 60C 100-105

Plate 2, Figure 22, 23

Test elongate, tapering from acute initial end to greatest breadth at apertural end, rounded triangular in transverse section, triserial throughout; chambers numerous, compressed and obscured in early portion then becoming inflated, gradually larger to the last formed chamber; sutures slightly impressed, fairly distinct; wall, arenaceous with much

siliceous cement obscuring fine sand grains yielding a somewhat smooth surface; aperture obscure but suggestion of opening at inner margin of last formed chamber.

Hypotype locality: Cameron R., 174' outcrop, 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Hypotype: University of Alberta Palaeontological Type Collection.

Verneuilina 60C 165-174B

Plate 2, Figure 24

Test elongate, gradually tapering from initial end for one half the length then sides almost parallel to the apertural end; end view, triangular, two equal acute angles and one obtuse; chambers numerous, fairly distinct, impressed; wall arenaceous with fine sand grains being obscured in much siliceous cement yielding a somewhat smooth surface; aperture opening at inner margin of last formed chamber.

Length of hypotype 0.52 mm., maximum breadth of hypotype 0.27 mm.

Hypotype locality: Cameron R., 174' outcrop, 14 miles straight south of south shore of Tathlina Lake, N.W.T.

Remarks: This species has striking resemblance to Verneuilina 360 B Trollope 1951 from the Upper Loon River formation. Both forms are triangular in cross section but V. 60C 165-174B has a withered compressed appearance to it and one vertical row of chambers is compressed.

EXPLANATION OF PLATE 1

All specimens are from Locality 60C, 174' outcrop section on the Cameron River, 14 miles south of the south shore of Tathlina Lake. All illustrations of hypotypes are retouched photographs of X60 drawings.

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Figure 3:	*Proteonina* 60C 110-120, X62	50
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PLATE 1.

Upper Albian Foraminifera -- Cameron Hills, N. W. T.


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EXPLANATION OF PLATE 2

All specimens are from locality 60C, a 174' outcrop on the Cameron River, 14 miles south of the south shore of Tathlina Lake. All illustrations of hypotypes are retouched photographs of X60 drawings.

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PLATE 2.

Upper Albian Foraminifera -- Cameron Hills, N. W. T.


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EXPLANATION OF PLATE 3

All specimens designated 61C are from an 88 foot outcrop section on the Cameron River, 11½ miles south of the south shore of Tathlina Lake. All specimens designated 69C are from a 23 foot outcrop section in close proximity to the Sixth Meridian 3 3/4 miles south of the south shore of Tathlina Lake. All illustrations of hypotypes are retouched photographs of X60 drawings.

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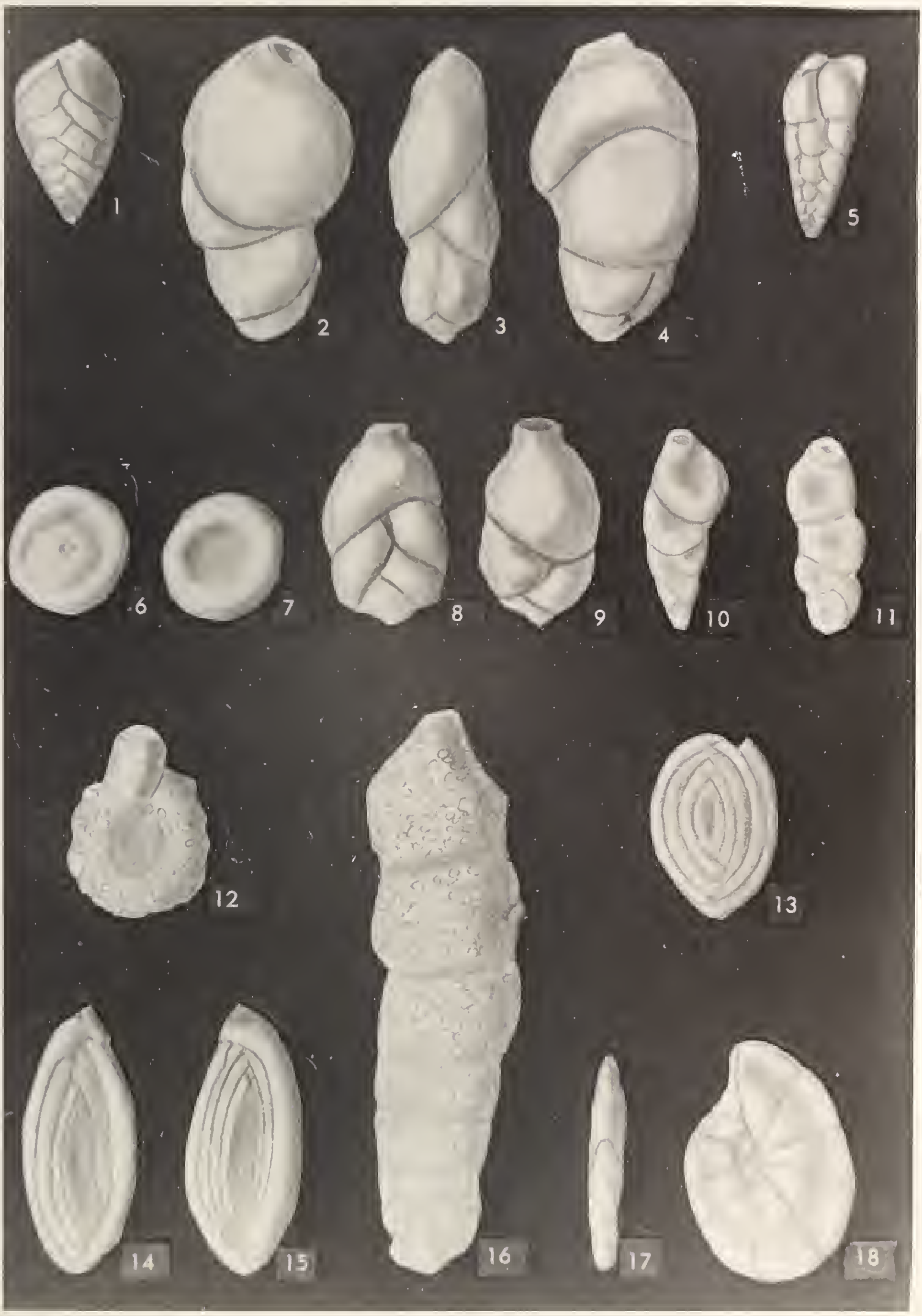
PLATE 3.

Upper Albian Foraminifera -- Cameron Hills, N. W. T.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APPENDIX

Description of Outcrop

The description of samples was undertaken at the University of Alberta and is supplemented by the writer's field notes. Zero footage denotes top of outcrop section.

Location 60C 174' outcrop on the Cameron R., 14 miles south of the south shore of Tathlina Lake.

Footage	
0 - 5	Shale; lt. gray; platy tending to be fissile; somewhat bentonitic.
5 - 10	Shale as above but more platy.
10 - 15	Shale as above; at 15' is a 1" band of yellow bentonite. Note: Samples 0-15' might possibly be slightly reworked or slumped shale.
15 - 20	No sample taken.
20 - 25	Shale; med. gray; platy tending to be fissile.
25 - 30	Shale; lt. gray; platy.
30 - 35	Shale; lt.-med. gray; blocky might be well classified as a mudstone; conchoidal fracture.
35 - 40	Shale as above.
40 - 45	Shale as above; with tendency to break in large fragments.
45 - 50	Shale; lt. gray; hard; platy.
50 - 55	Shale as above; tending to be more fissile.
55 - 60	Shale; med. gray; platy tending to be fissile; rusty weathering on parting surfaces.
60 - 65	Shale as above.
65 - 70	Shale as above with siltstone; lt. gray; finely bedded; rusty weathering.

70 - 75	Shale as above but more fissile.
75 - 80	Shale as above.
80 - 85	Shale as above.
85 - 90	Shale as above.
90 - 95	Shale as above but more blocky.
95 - 100	Shale as above.
100 - 105	Shale as above becoming more fissile.
105 - 110	Shale as above.
110 - 120	Shale; med. gray; hard; fissile; rusty weathering.
120 - 130	No sample.
130 - 140	Shale as above but softer.
140 - 150	Shale; med. gray; hard; platy to fissile.
150 - 155	Shale as above but more platy.
155 - 160	Shale as above but becoming blocky.
160 - 165	Shale as above.
165 - 174	Shale; med. gray with a blue green cast; hard; conchoidal parting; tending to break in large fragments; fossiliferous in part <u>Gastroplites</u> (Neogastroplites?) sp. and <u>Oxytoma pinania</u>. At 173' 6" hard siltstone band.
174'	Water level.
NOTE:	Samples described when dry and therefore lighter in color than in outcrop section:- Medium gray in the laboratory would probably be dark gray in the field.
	Water level of this outcrop is approximately 125 feet above the top of the outcrop of Location 61C.

<u>Location 61C</u> 88' outcrop on the Cameron River 11½ miles straight south of the south shore of Tathlina Lake.

0 - 10	Shale, med. gray with greenish cast, blocky, conchoidal fracture; tending to be rusty weathering.
10 - 20	Shale as above; tending to be more platy.
20 - 27	Shale as above.

27 - 27'6"	Shale; med. gray but lighter in color than as in 20 - 27; hard; platy.
27'6" - 30	Shale; as in 20 - 27.
30 - 40	Shale; lt. gray; platy, tending toward fissile; rusty weathering along fracture planes.
40 - 50	Shales as in 10 - 20'. At 49' is a band of nodular ironstone.
50 - 60	Shale as above; tendency to break in thin curved flakes conchoidal fracture.
60 - 70	Shale as above; only more fissile. At 69' an ironstone nodular band is present.
70 - 80	At 70' an ironstone nodular band is present. Shale; med. gray with a blue-green cast; blocky with conchoidal fracture; hard.
80'	Ironstone nodular band.
80 - 88	Water level. No sample taken as cover too thick. Over 300 feet of section is estimated between water level and the top of the outcrop of Location 69C.

<u>Location 69C</u> 23' outcrop on unnamed stream in close proximity to the Sixth Meridian, 3 3/4 miles south of the south shore of Tathlina Lake.

0 - 5	Shale; medium gray; hard; blocky to platy; selenite crystals present. At 4' a 4" ironstone band is present.
5 - 10	Shale; medium gray; hard; fissile; carbonaceous; selenite present. At 7'8" and 10' are 3" ironstone bands present.
10 - 15	Shale as above.
	At 14' and 15' are 3" and 2" ironstone bands respectively.
15 - 20	Shale as above.
20 - 24	Shale as above with a 6" ironstone band at 21'.
23'	Water level.

Some Generic Observations of the Microfauna of the Described Sections

The genera are listed in order of abundance. Brackets indicate that a species of the enclosed genus has been described from the given footages. Footages are from top of outcrop (zero footage) to water level.

Location 60C

25 - 30	Ammobaculites and Haplophragmoides equal in number followed in number by Miliammina, cutinized microfossils, and Leptodermella; no forms described.
30 - 35	Cutinized microfossil, Miliammina, Haplophragmoides, and Ammobaculites (Haplophragmoides and Ammobaculites).
35 - 40	Haplophragmoides (40%), Ammobaculites, Miliammina, cutinized microfossils, Leptodermella and Verneuilina. (Nodosinella)
40 - 45	Cutinized microfossils and Ammobaculites predominant, Haplophragmoides, Miliammina and Leptodermella (Miliammina)
45 - 50	Ammobaculites (over 60%), Miliammina, cutinized microfossils and Haplophragmoides. (Eggerella).
50 - 55	Ammobaculites (over 55%), Haplophragmoides, Miliammina, cutinized microfossils, Verneuilina and Leptodermella. (Haplophragmoides).
55 - 60	Ammobaculites, Haplophragmoides and Miliammina.
60 - 65	Haplophragmoides, Ammobaculites, Verneuilina and cutinized microfossils.
65 - 70	Haplophragmoides and Ammobaculites predominate with a few Verneuilina.
70 - 75	Ammobaculites and Haplophragmoides.
75 - 80	As above.
80 - 85	As above with some Miliammina.
85 - 90	Ammobaculites and Haplophragmoides with Verneuilina in 100 mesh size screen.
90 - 95	Ammobaculites, Haplophragmoides. (Ammobaculites).
95 - 100	As above with Verneuilina in 100 mesh size screen.

100 - 105 As above with some Verneuilina (Ammobaculites A and B)

105 - 110 As above (Miliammina)

110 - 120 Haplophragmoides, Verneuilina, Ammobaculites and cutinized microfossils (Proteonina)

120 - 130 Not picked.

130 - 140 Haplophragmoides and Ammobaculites about equal, (Haplophragmoides, Verneuilina, Quadrimorphina, Ammobaculites A and B).

140 - 150 Haplophragmoides, Ammobaculites (Haplophragmoides)

150 - 155 Ammobaculites predominate, Miliammina, Verneuilina are more abundant in 100 mesh size screen and Haplophragmoides in 80 mesh size screen. (Miliammina).

155 - 160 Ammobaculites over 80%, Haplophragmoides (Ammobaculites)

160 - 165 Ammobaculites, Miliammina, Haplophragmoides, Proteonina and Verneuilina present in 100 mesh size screen (Ammobaculites, Ammodiscus, Proteonina A and B.)

165 - 174 Haplophragmoides, Verneuilina, Ammobaculites and Miliammina. (Ammobaculites A and B, Trochammina, Verneuilina A and B, Haplophragmoides.) Gastroplites (Neogastroplites?) sp. and Oxytoma pinania found at 168 feet.

Location 61C

0 - 10 Ammobaculites, Gaudryina, Trochammina (Ammobaculites, Haplophragmoides, Textularia).

10 - 20 Haplophragmoides, Verneuilina, Gaudryina with a few Miliammina.

20 - 30 Haplophragmoides, Verneuilina, Trochammina. Tritaxia 61C 40 - 50 and Haplophragmoides gigas minor Nauss present.

30 - 40 Haplophragmoides, Verneuilina, Ammobaculites, Trochammina with a few Tritaxia and Miliammina. Tritaxia 61C 40 - 50 and Haplophragmoides linki Nauss present. (Verneuilina, Eggerella.)

40 - 50 Haplophragmoides, Verneuilina, Ammobaculites, Trochammina, with a few Tritaxia and Miliammina present. (Tritaxia).

50 - 60 As above with Gaudryina present.

60 - 70 As above (Tritaxia)

70 - 80 As above Haplophragmoides gigas minor Nauss present. (Proteonina)

Location 69C

0 - 5 Barren

5 - 10 Haplophragmoides small size; practically barren.

10 - 15 Miliammina (50%) Haplophragmoides (25%) Leptodermella (14%) Tritaxia and a very few cutinized microfossils (Ammobaculites, Leptodermella, Miliammina A and B, Tritaxia A and B.)

15 - 23 Practically barren.

BIBLIOGRAPHY

1. Bahan, W. G. (1951), "Microfauna of the Joli Fou Formation in North Central Alberta", (unpublished M.Sc. thesis, Univ. of Alberta).

2. Bullock, D. B. (1950), "A Microfaunal Study of the Basal Lloydminster Shale", (unpublished M.Sc. thesis, Univ. of Alberta).

3. Cameron, A. E. (1921), "Hay and Buffalo Rivers, Great Slave and Adjacent Country", G.S.C. Summ. Rept. 1921, pt B, pp. 1-44, 1922.

4. Chapman, F., (1899) "Foraminifera from the Cambridge Greensand," Pt 1, Ann. Mag. Nat. Hist. London, England, 1899 ser. 7, Vol. 3, No. 15, p. 56.

5. Cushman, J. A. (1946) "Upper Cretaceous Foraminifera of the Gulf Coast Region, etc." U.S. Geol. Survey , Prof. paper, No. 206.

6. Howard, R. A. and Moffet, C. E. (1954), "A Microfaunal Study of the Halfway Suite", (unpublished report, Univ. of Alberta).

7. Loeblich, A. R., Jr., and Tappan, J. (1949), "New Kansas Lower Cretaceous Foraminifera", Wash. Acad. Sci. Jour., Washington, D.C. 1949, vol. 39, No. 3, p. 90.

8. Loeblich, A. R., Jr., and Tappan H., (1950) "Foraminifera of the Type Kiowa Shale, Lower Cretaceous of Kansas" Univ. of Kansas Publication, Feb. 24, 1950, Article 4, pp. 1-23.

9. Nauss, A. W., (1947), "Cretaceous Microfossils of the Vermilion Area, Alberta," Jour. of Pal., Vol. 21, No. 4, pp. 329-343.

10. Mellon, G. B., (1955) "Age and Origin of the McMurray Formation" (unpublished M.Sc. thesis, Univ. of Alberta).

11. Mellon, G. B. and Wall, J. H., (1956) "Geology of the McMurray Formation" Research Council of Alberta, Rept. No. 72.

12. Nielsen, A. R., (1950), "A Microfaunal Study of the Shaftesbury Formation", (unpublished M.Sc. thesis, Univ. of Alberta)

13. Martin, L. J., (1954) "Clearwater Shale Foraminifera, Athabasca River, Alberta," (unpublished M.Sc. thesis, Univ. of Alberta)

14. McLearn, F. H. (1918), "Peace River Section, Alberta, G. S. C. Summ. Rept., 1917 pt. c, pp. 14-21, 1918.

15. Stelck, C. R. (1950) "Cenomanian - Albian Foraminifera of Western Canada", (unpublished Ph.D. thesis Stanford University, 1950)

16. Trollope, F. H., (1951) "A Lower Microfauna of the Loon River Formation, Northern Alberta", (unpublished M.Sc. thesis, Univ. of Alberta)

17. Whittaker, E. J., (1921) "Mackenzie River District between Great Slave Lake and Simpson", G.S.C. Summ. Rept., 1921 Pt. B.

18. Wickenden R. T. D. (1932) "New Species of Foraminifera from the Upper Cretaceous of the Prairie Provinces", Trans. Roy. Soc. Can., Vol. xxvi, Sec. 4, pp. 85-91.


WESTERN
CANADA
CRETACEOUS
ARCTIC
SEA
HUDSON
BAY
AKLAVIK
GREAT
BEAR
L.
NORMAN
WELLS
MACKENZIE RIVER
KEEL R.
DAWSON
YUKON
YUKON RIVER
ALASKA
WHITEHORSE
GREAT
SLAVE
L.
MACKENZIE
KEEWATIN
MANITOBA
DISTRICT OF ALBERTA
LIARD R.
PEACE R.
LAKE
ATHABASCA
CHURCHILL R.
NELSON R.
FORT NELSON
MCMURRAY
SASKATCHEWAN R.
L. WINNIPEG
WINNIPEG
NORTH SASKATCHEWAN
FORT ST. JOHN
SASKATOON
REGINA
EDMONTON
SOUTH
ATHABASCA R.
SKEENA R.
BRITISH
COLUMBIA
PRINCE GEORGE
FRASER R.
PRINCE RUPERT
CALGARY
COLUMBIA R.
SASKATCHEWAN
N. DAKOTA
MONTANA
MISSOURI R.
PACIFIC
OCEAN
VICTORIA
0 KILOMETRES 400
0 MILES 200